Investigation of the optical and electrical parameters of As47. 5Se47. 5Ag5 thin films with different thicknesses for optoelectronic applications

Abstract

The impact of film thickness on both optical and electrical parameters of amorphous $As_{47.5}Se_{47.5}Ag_5$ thin films at different thickness (174–1383 nm) was studied. In this study the envelope method was employed to determine the optical parameters of the studied films using the experimentally measured data of the optical transmittance T_λ. The optical absorption data of the investigated films at all different thicknesses was successfully described by Tauc's relation and it was found that the optical absorption mechanism follows the allowed indirect transition rule. Analyzing the results showed that the optical band gap decreases and localized states width increases with increasing the film thickness. Furthermore, the refractive index as well as dispersion parameters of $As_{47.5}Se_{47.5}Ag_5$ thin films were discussed using the single oscillator model suggested by Wemple-DiDomenico. The D.C electrical conductivity of the investigated films in the temperature region (300–588 K) was investigated. In the higher temperature region (400–588 K) the conduction mechanism refer to the conduction of the carriers excited into the extended states, while at lower temperature region (300–400 K) the conduction mechanism is due to carriers transport in the localized states near the valence and conduction bands. The Mott's parameters were calculated as a function of the film thickness near the Fermi level of the studied films. The results revealed that the variation of the film thickness strongly affects the optical as well as the electrical parameters of $As_{47.5}Se_{47.5}Ag_5$ thin films.